ROFI Bipedal Robot

Written By: Jonathan Dowdall

TOOLS:

- MakerBot Thing-O-Matic 3D Printer Kit (1)

PARTS:

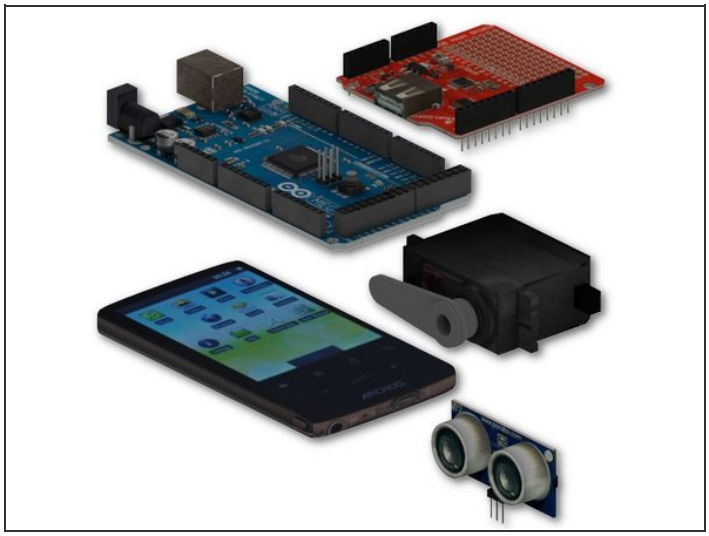
- See initial step for link to parts list. (1)

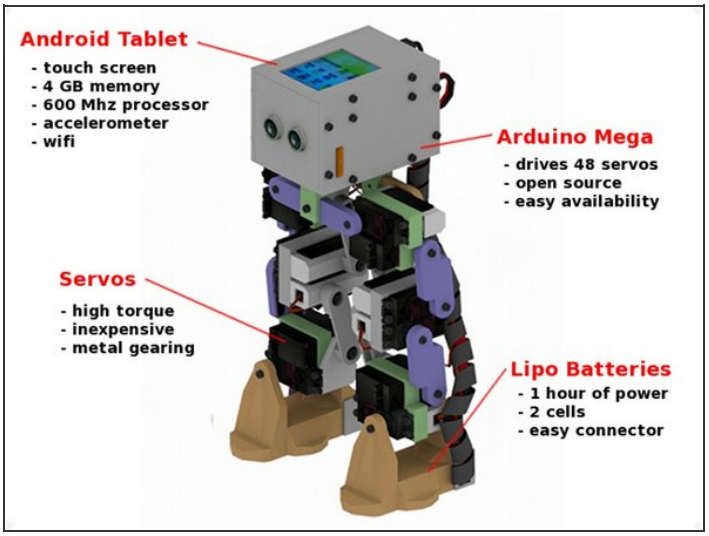
SUMMARY

Building ROFI is a great way to develop your robotics skills, learn a bit about programming, and have some fun making the robot walk. ROFI is the 5th robot from Project Biped and builds on the lessons learned from the previous generations. All of the structural parts of the robot can be printed on a hobby-grade 3D printer in about 24 hours, and a full list of the other parts (with vendor links where I bought the parts from) is provided. The total cost for the parts is around $350 (excluding shipping), which isn't too bad considering that includes a full Android tablet, 12 servos, an Arduino Mega board and Lipo batteries.

Source code for the Arduino mega and the Android tablet is provided along with instructions on how to upload the code onto the devices, so even beginners can get the robot walking. There is also a free open source desktop application I developed that allows you to modify existing walking cycles and create your own action sequences for the robot using a computer.

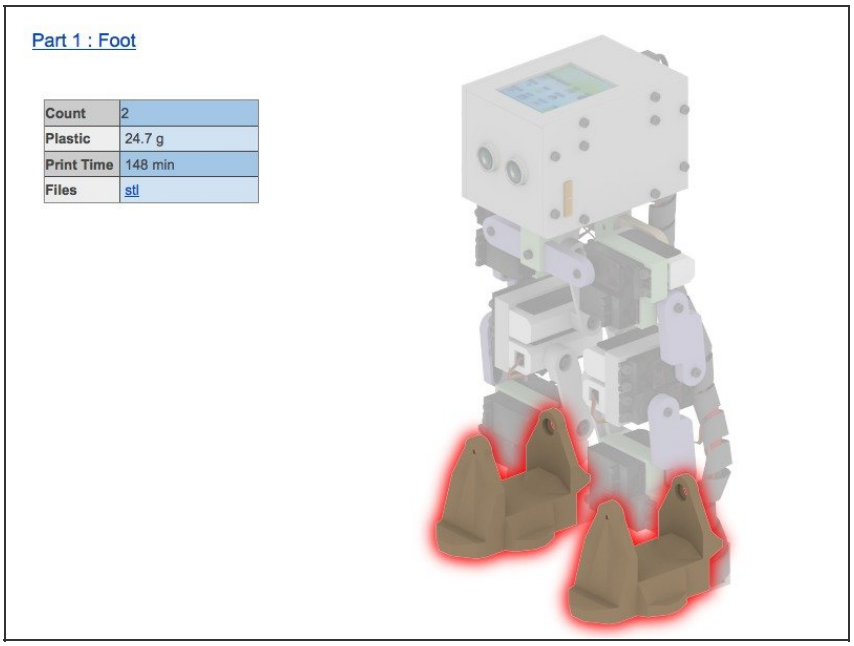
Step 1 — ROFI Bipedal Robot





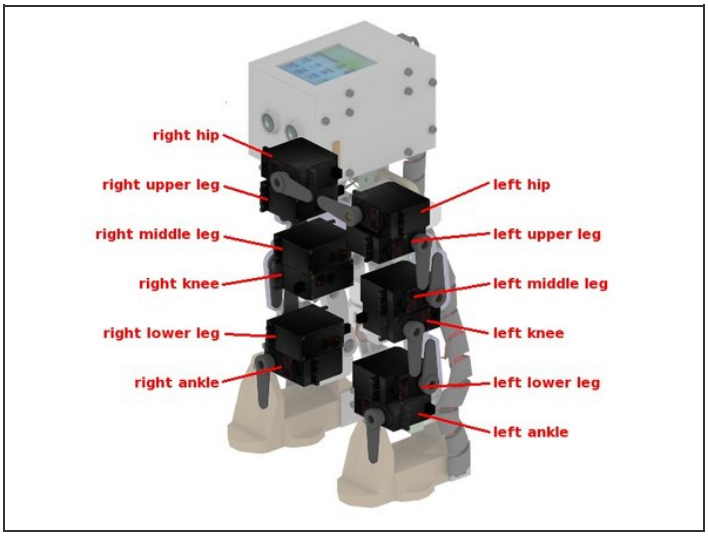
- The first thing you'll need to do is order the non-structural parts as they can take awhile to come in. The parts list for ROFI contains the quantity, price, and vendor link for each non-printed part in the robot.
- I don't have any affiliation with any of the vendors. If you find the same part for cheaper let me know and I'll update the list.

Step 2



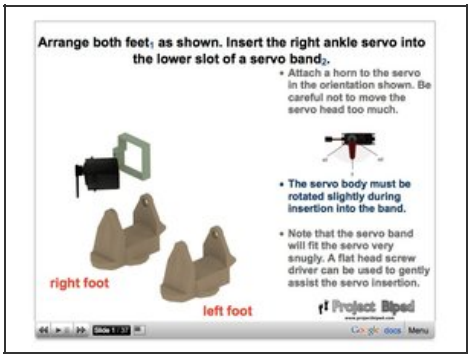
- Print out all of the structural components of the robot. ROFI is made of 22 different parts. Several of these appear more than once in the robot for a total of 35 parts.
- All of the parts were designed to be 3D printed and can be made on a hobby-grade 3d printer in about 24 hours. The 3D printer needs to have a build volume of at least 4.5"x 4.5"x 3.0".
- The first ROFI was printed on a Makerbot Thing-O-Matic out of ABS plastic.

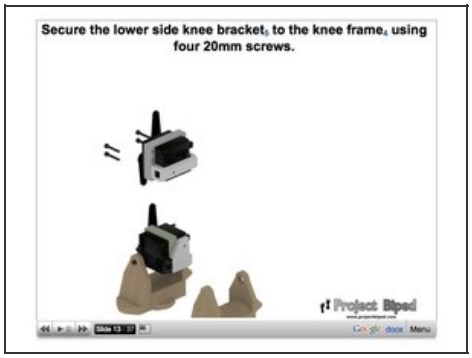
Step 3

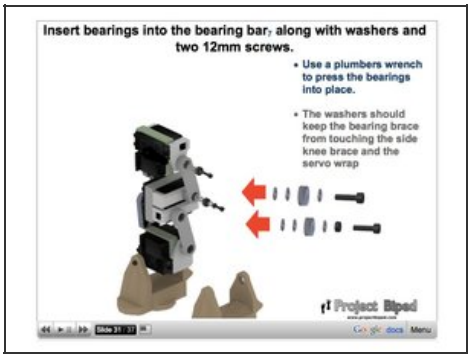


- ROFI contains 12 servos (6 in each leg). Before the robot is assembled, each servo needs to be centered.
- Centering the servos makes calibration much easier once the robot is complete.
- The centering process requires your Arudino Mega board and should take about 10 minutes.

Step 4

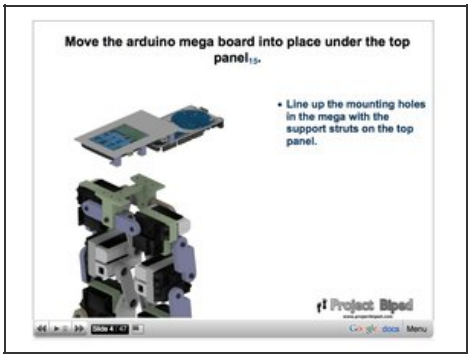


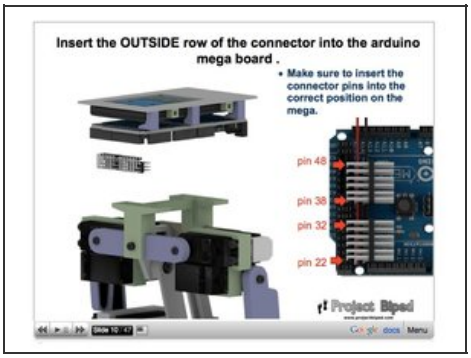


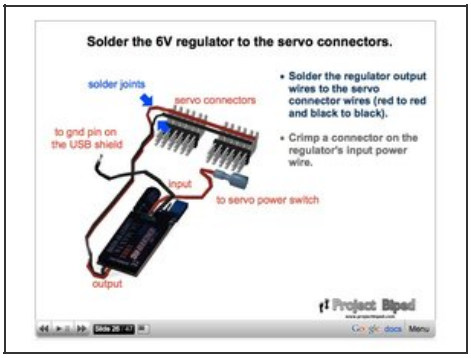


- The next step is to build the legs of the robot. This should take about an hour per leg.
- The leg assembly process is broken into 37 steps. The leg assembly presentation has detailed instructions and animated diagrams for each step (the photos are screen shots).
- Don't be intimidated; there are so many steps because each one is simple!

Step 5

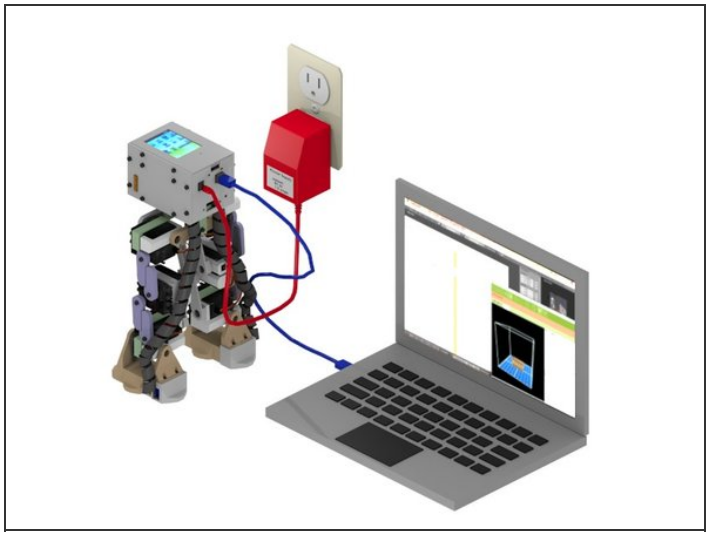


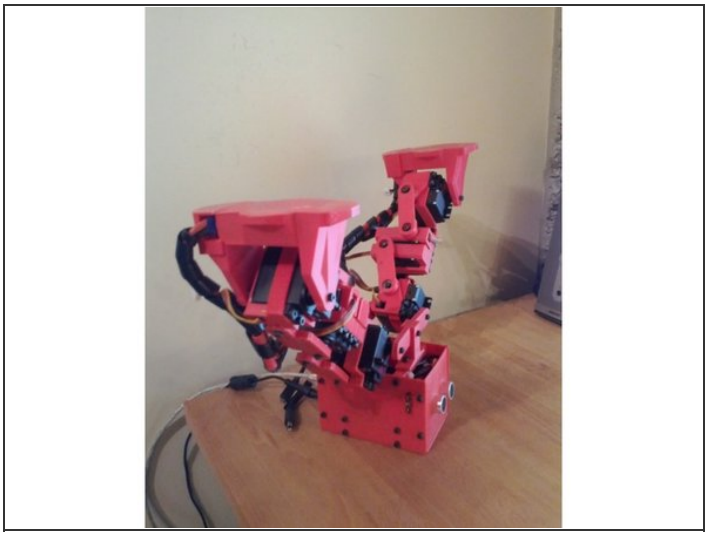




- The body assembly process is broken into 47 steps. The body assembly presentation has detailed instructions and animated diagrams for each step (the photos are screen shots).
- Assembling the body should take around 2 hours.
- You'll need some basic soldering skills to complete this step.
- Don't worry, each step is small!

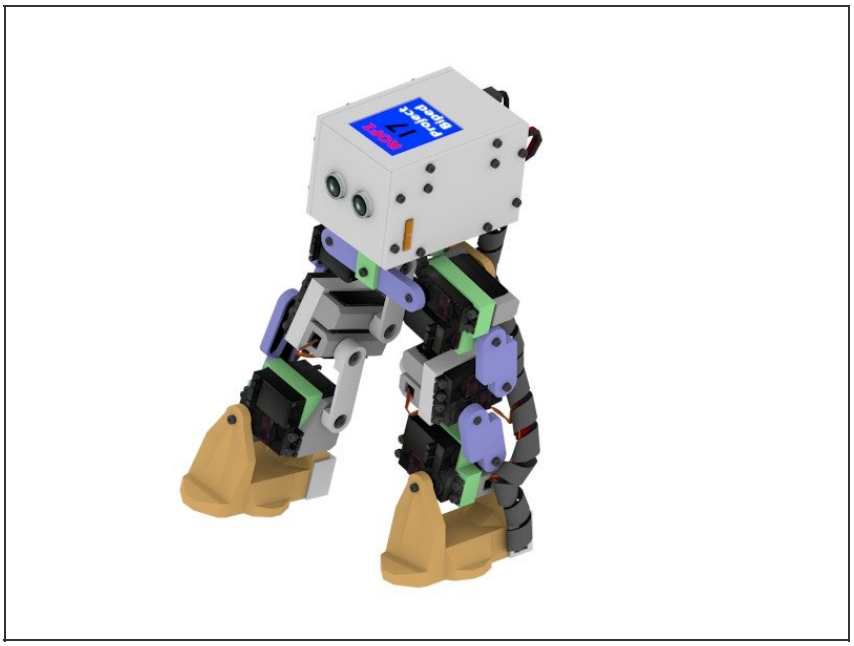
Step 6





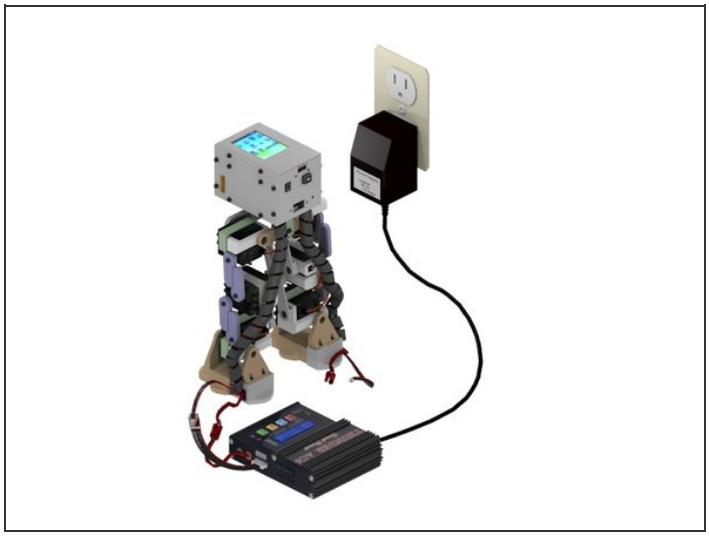
- Now the servos need to be calibrated before the robot can walk.
- The calibration instructions (lower right panel) show you how to use the Robot Poser application to calibrate the robot.
- The calibration looks a little involved, but should only take about 20 minutes. Also it only needs to be done once.

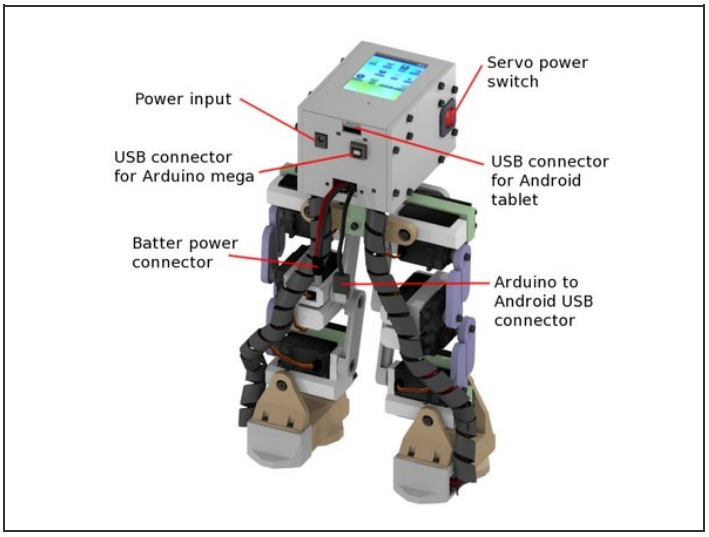
Step 7



- Now let's get ROFI walking!
- First try the static walking using just the Arduino Mega (the robot can be actuated without the Android tablet).
- The static walking sequence is composed of 10 individual poses that are each statically balanced. This means that if the robot were to stop at any frame it won't fall over.
- Video of the static walk.
- More info about ROFI's walking cycles.

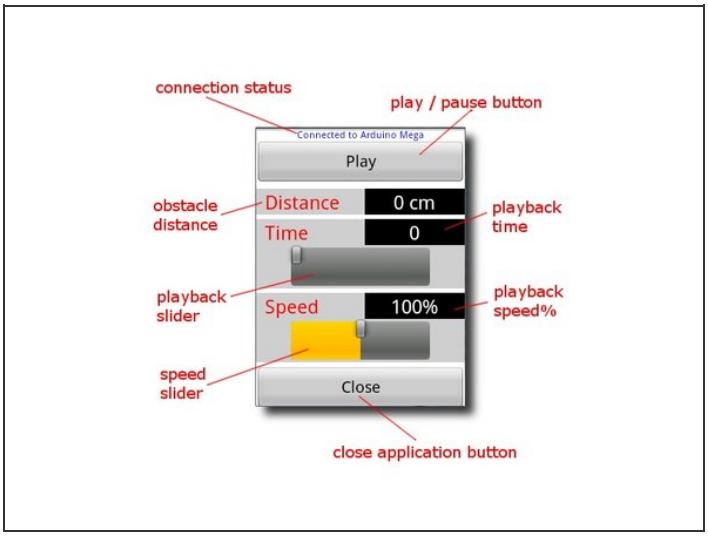
Step 8

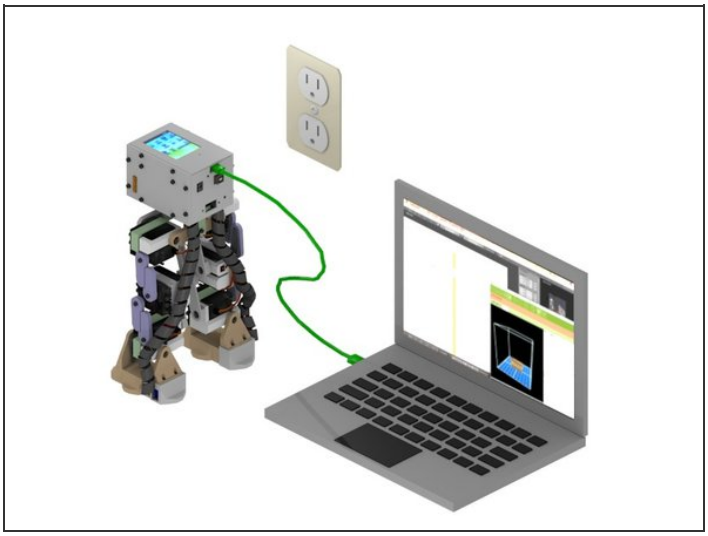




- Next thing is to free ROFI from the wires!
- Unplug the power adapter and USB cables.
- Recharge your batteries. The robot uses LIPO (Lithium Polymer) batteries with 2 cells, so it needs a special kind of recharger called a balance charger. There is a link on the parts list to the vendor where I got mine.
- Once the batteries are recharged and all of the cables are reconnected, plug the battery power line into the Arduino Mega board and flip the servo power switch to get ROFI walking autonomously!
- Remember to unplug the battery power cable from the Arduino Mega after you're done! Power still goes to the board even if you've turned off the servo power switch, and draining the batteries completely will damage them.

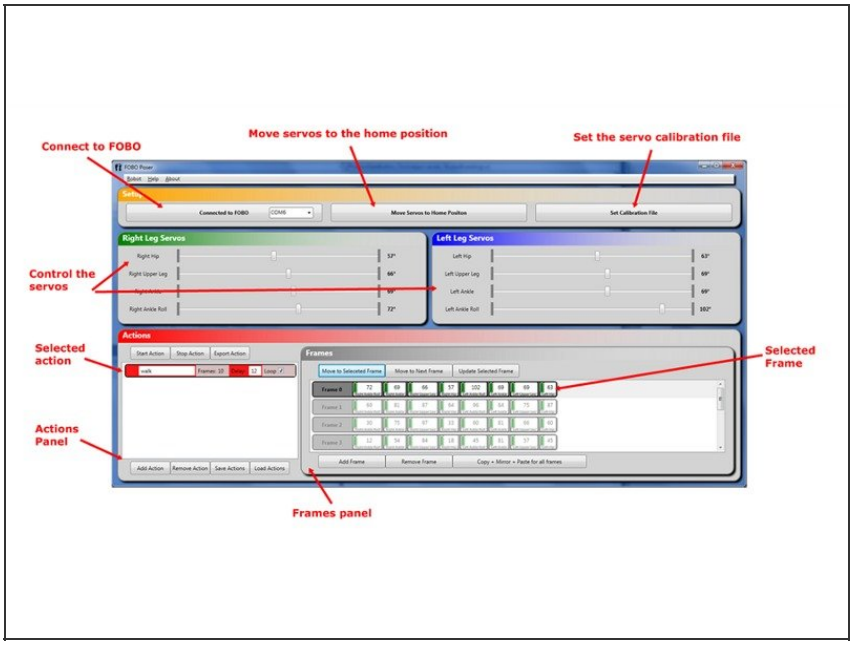
Step 9





- Now it is time to start using the Android tablet in ROFI's head to control the robot. The Arduino Mega will act as a hardware interface in this mode and will also charge the tablet via the USB host shield.
- Set up the Android development environment on your computer. Note that this was harder than I thought it should be, so hopefully the instructions will save you some time!
- Upload the non-static walking cycle program to the Android tablet and the Remote Control From Android program to the Arduino Mega
- When you're ready you can put the full Navigation program onto the Android tablet. This allows ROFI to walk around autonomously and avoid obstacles!

Step 10



- The last step is to use the Robot Poser application to create new action sequences for ROFI.
- The create new action presentation is from the previous robot, FOBO, but is still applicable (I'll update the presentation soon).
- You can modify any of the existing actions or create your own from scratch.
- Don't forget to load your calibration file when you start the application! Using the calibration means that you'll only need to make half of the frames (for symmetric actions like walking) and other people will be able to use your action if you want to share.
- The application is open source, so if you want to play around with a little C# you can set up the Visual Studio development environment and have some fun.

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